Name_____ Student ID_____ Department/Year_____

Final Examination

Introduction to Computer Science
Class#: 901 E10110, Session#: 03
Spring 2006

15:40-17:20 Wednesday
June 21, 2006

Prohibited

1. You are not allowed to write down the answers using pencils. Use only black- or blue-inked pens.
2. You are not allowed to read books or any references not on the question sheets.
3. You are not allowed to use calculators or electronic devices in any form.
4. You are not allowed to use extra sheets of papers.
5. You are not allowed to have any oral, visual, gesture exchange about the exam questions or answers during the exam.

Cautions

1. Check if you get **10** pages (including this title page), **15** questions.
2. Write your name (in Chinese), student ID, and department/year down on top of the cover page.
3. There are in total **100** points to earn. You have **100 minutes** to answer the questions. Skim through all questions and start from the questions you feel more confident with.
4. You are allowed to use **only English** to answer the questions. Misspelling and grammar errors will be tolerated, but you want to make sure with those errors your answers will still make sense.
5. If you have any extra-exam emergency or problem regarding the exam questions, raise your hand quietly. The exam administrator will approach you and deal with the problem.

The following table is from Appendix C of the textbook. It is included here to facilitate the language translation required in Question 13.

Op-Code	Operand	Description
1	RXY	LOAD the register R with the bit pattern found in the memory cell whose address is XY. *Example:* 14A3 would cause the contents of the memory cell located at address A3 to be placed in register 4.
2	RXY	LOAD the register R with the bit pattern XY. *Example:* 20A3 would cause the value A3 to be placed in register 0.
3	RXY	STORE the bit pattern found in register R in the memory cell whose address is XY. *Example:* 35B1 would cause the contents of register 5 to be placed in the memory cell whose address is B1.
4	0RS	MOVE the bit pattern found in register R to register S. *Example:* 40A4 would cause the contents of register A to be copied into register 4.
5	RST	ADD the bit patterns in registers S and T as though they were two's complement representations and leave the result in register R. *Example:* 5726 would cause the binary values in registers 2 and 6 to be added and the sum placed in register 7.
6	RST	ADD the bit patterns in registers S and T as though they represented values in floating-point notation and leave the floating-point result in register R. *Example:* 634E would cause the values in registers 4 and E to be added as floating-point values and the result to be placed in register 3.
7	RST	OR the bit patterns in registers S and T and place the result in register R. *Example:* 7CB4 would cause the result of ORing the contents of registers B and 4 to be placed in register C.
8	RST	AND the bit patterns in register S and T and place the result in register R. *Example:* 8045 would cause the result of ANDing the contents of registers 4 and 5 to be placed in register 0.
9	RST	EXCLUSIVE OR the bit patterns in registers S and T and place the result in register R. *Example:* 95F3 would cause the result of EXCLUSIVE ORing the contents of registers F and 3 to be placed in register 5.
A	R0X	ROTATE the bit pattern in register R one bit to the right X times. Each time place the bit that started at the low-order end at the high-order end. *Example:* A403 would cause the contents of register 4 to be rotated 3 bits to the right in a circular fashion.
B	RXY	JUMP to the instruction located in the memory cell at address XY if the bit pattern in register R is equal to the bit pattern in register number 0. Otherwise, continue with the normal sequence of execution. (The jump is implemented by copying XY into the program counter during the execute phase.) *Example:* B43C would first compare the contents of register 4 with the contents of register 0. If the two were equal, the pattern 3C would be placed in the program counter so that the next instruction executed would be the one located at that memory address. Otherwise, nothing would be done and program execution would continue in its normal sequence.
C	000	HALT execution. *Example:* C000 would cause program execution to stop.

1. If a domain's network identifier is 0001001000001100,
    (a) what is the address in IP address's dotted decimal notation? (4%)
    (b) how many unique IP addresses are available for referencing computers within the domain? (4%)

ANSWER:
(a) 18.12
(b) $2^{16} = 65535$

2. Describe the steps followed by a machine that wants to transmit a message in a network using the CSMA/CS protocol. (4%)

ANSWER:
Refer to the homework solution.

3. Name at least one distinction between UDP and TCP? (4%)

ANSWER:
(1) UDP is a connectionless protocol whereas TCP establishes a two way communication between the origin and destination of a message.
(2) TCP is a reliable protocol in that the origin and destination work together to confirm that the entire message was successfully transferred. In contrast, UDP merely transmits the message without confirming it reception.

4. Map these networking terms ‘domain’, ‘protocol’, ‘IP address’, ‘ISP’, ‘router’, ‘Ethernet’, ‘TCP’, ‘URL’: (8%)

(a) A governing set of rules
(b) A protocol for the network layer
(c) A means of implementing a network with the bus topology
(d) A portion of the Internet
(e) A means of connecting networks
(f) A message segment that is transmitted over the Internet independently
(g) Identifies a machine on the Internet
(h) A means of obtaining access to the Internet
(i) A protocol for the transport layer
(j) A means of identifying a document on the Web
(k) A network of networks

ANSWER:
(d), (a), (g), (h), (e), (c), (i), (j)

5. What would happen if a user clicked the mouse on the term “pig” while viewing the html document shown below? (4%)

```
<html>
<head>
<title>This is the title</title>
</head>
<body>
<h1>Favorite Animals</h1>
<p>Of all the animals in the world, the
<a href=”http://pigs.org/pigs.html”>pig</a> is
perhaps the most charming.</p><p>However, the
<a href=”http://hippopotamuscity.org/hippo.html”>
hippopotamus</a> is also cute.</p>
</body>
</html>
```

ANSWER:
The browser would retrieve and display the document pigs.html.

6. What sequence of numbers would be printed when the following procedure are executed? (4%)

```
X ← 5;
while (X < 7) do
 (print the value of X;
  X ← X + 1)
print the value of X;
while (X > 2) do
 (print the value of X;
  X ← X - 2)
```

ANSWER: 5, 6, 7, 7, 5, 3

7. When searching for the entry X within the list:

R, S, T, U, V, W, Z

(Note that the list is in alphabetical order.)

(a) how many entries will be considered before discovering that the entry is not present using the sequential search algorithm? (4%)
(b) how many entries will be considered before discovering that the entry is not present using the binary search algorithm? (4%)

ANSWER:
(a) 7, (b) 3

8. What sequence of numbers would be printed if the following procedure were executed with the value of N being 0? (8%)

```
procedure xxx (N)
print the value of N;
if (N < 5) then (apply the procedure xxx to the value N + 2);
print the value of N
```

ANSWER: 0, 2, 4, 6, 6, 4, 2, 0

9. Use a while loop structure to produce a non-recursive program segment that prints the same sequence of numbers as the following recursive procedure. (8%)

```
procedure xxx (N)
print the value of N:
if (N < 5) then (apply the procedure xxx to the value N + 1)
```

ANSWER:

```
print the value of N;
while (N < 6) do
    (print the value of N;
     N ← N + 1)
```

10. Does the loop in the following routine terminate? Explain your answer.
Explain what might happen if this routine is actually executed by a computer. (8%)

```
X ← 3
while (X ≠ 8) do
  (X ← X + 2)
```

ANSWER:

No. The termination condition will never be reached because X will always be odd.
The computer will stay in the loop forever and never terminates.

11. The following is a program segment and the definition of a procedure named sub.

```
X ← 3;                          procedure sub (Y)
sub (X);                           Y ← 5;
print the value of X;
    .
    .
```

(a) What value will be printed by the program segment if parameters are passed by value? (4%)

(b) What value will be printed by the program segment if parameters are passed by reference? (4%)

ANSWER: A. 3 B. 5

12. Based on the sketch of a class definition below, which methods can be invoked from outside an instance of the class? (4%)

```
class Example
{public void method1( )
   { . . . }
 private void method2( )
   { . . . }
 public void method3( )
   {…}
 private void method4( )
   { . . .}
}
```

ANSWER: method1 and method3

13. (a) Translate the high-level statement

```
if (X equals 0)
    then Z ← Y + W
    else Z ← Y + X
```

into the machine language of Appendix C, assuming that W, X, Y, and Z are all values represented in two's complement notation, each using one byte of memory. Assume the program starts at address 00. Let W stored in the memory with address WW, X with address XX, Y with address YY, and Z with address ZZ. (8%)

(b) Was it necessary to identify the type of data associated with the variables in order to translate the statements? Why do many high-level programming languages require the programmer to identify the type of each variable at the beginning of a program? (4%)

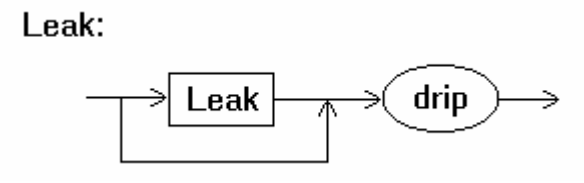
ANSWER:

(a)

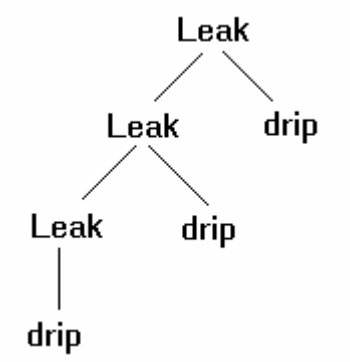
00	2000
02	11XX
04	12YY
06	B10E
08	5012
0A	30ZZ
0C	C000
0E	11WW
10	B008

(b) The op-code for adding two binary values maybe different depending on whether the two values are two integers or two real numbers.

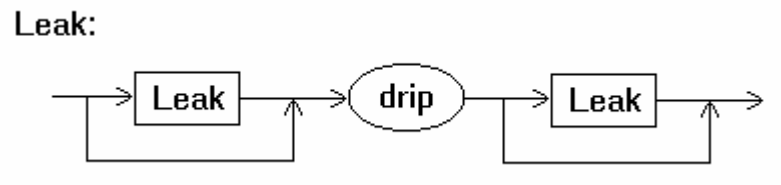
14. Based on the grammar below, draw a parse tree showing that the string “drip drip drip” is a Leak. (4%)



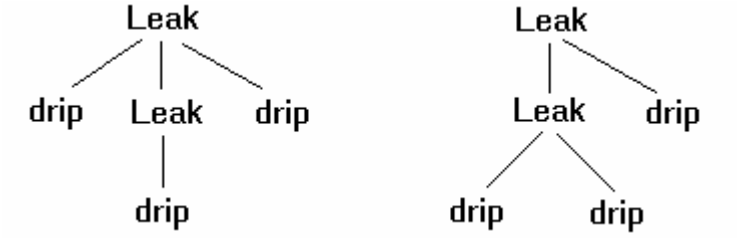
ANSWER:

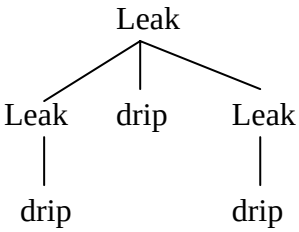


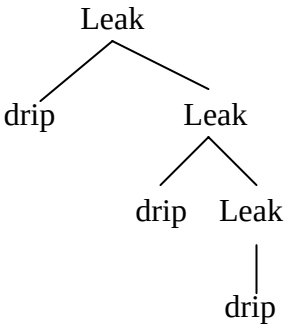
15. Show that the grammar below is ambiguous by drawing two distinct parse trees for the string “drip drip drip.” (8%)



ANSWER:
Possible answers include:




Leak
Leak
drip
Leak
drip
drip


Leak
drip
Leak
drip
Leak
drip